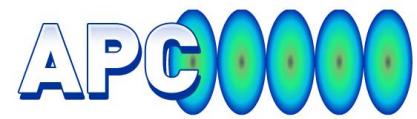


Summary of MUTAC Review

April 8-10, LBNL

Vladimir Shiltsev

Fermilab



Charge and Committee

Review and comment on the R&D progress achieved since the last MUTAC (NFMCC and MCTF):

Assess and comment on results and possible follow up to the MERIT experiment.

Assess and comment on the MUCOOL R&D program

Assess program and comment on first results from the international MICE experiment.

Review and comment on Simulation Group accomplishments and plans, including NF design optimization, FFAG acceleration system activities, MC studies, and participation in the IDS

Review and comment on goals, strategy, and progress in the Muon Collider design and technology development programs.

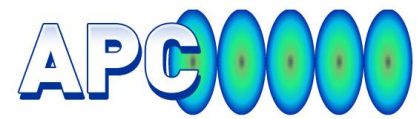
Review and give advice on the R&D plans and corresponding budgets for FY08 and directions for FY09.

Offer comments/advice as appropriate, on longer range strategies for the NFMCC and MCTF.

- Committee (besides MCOG and DoE's B.Weng) :
 - C.Adolphsen (SLAC), J.Byrd(LBNL), D.Finley (FNAL), S. Henderson (ORNL) R. Kephart (Chair, FNAL), M. Lindner (Germany), V.Litvinenko (BNL) ,P. McIntosh (Daresbury), D.Rubin (Cornell) ,M.Shaevitz (Columbia)

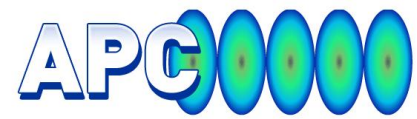
Key presentations

- <http://www.cap.bnl.gov/mumu/conf/MUTAC-080408/>
- NFMCC
 - MICE progress , 1st beam (Ellis et al)
 - MERIT – done! (Kirk et al)
 - IDS plans (Long) and EMMA (Kocshelniak)
- MCTF and joint
 - [Palmer, Fernow], [Jansson, Johnstone],
 - [Li, Huang, Bross], [Zlobin, Alvin], Rol
- Planning
 - NFMCC 5-yr plan update (Zisman)
 - MC long-term vision (VS) and A.Bross's summary



Committee's Summary (1)

- The extended timelines and costs of ILC, CLIC and the need for higher energy may increase the importance of the MC R&D
- Impressive MERIT results - Hg jet targets can work at >4MW
- The MICE beam line construction is done, testing begun, spectrometers near completion, coupling coils being fabricated.
- Endorses the HTS collaborations proposal to DOE/NSF.
- Neutrino Factory design work: ISS→IDS→HF RDR by 2012
- Endorse the goal of a Muon Collider feasibility Study by 2012.
- Strong int'l connections with Europe (UK) and Japan, large Chinese contribution to the MICE coupling coils.
- The committee supports a 5 yr integrated NFMCC and MCTF R&D plan with the 2012 goal of both the NF RDR and a MC feasibility report .



Committee's Summary (2)

- A needed factor of 3 increase in resources will require strong P5 support (no detailed justification for the \$\$ given to MUTAC)
- Impressed with the flow of new ideas for MC but given limited resources, options must be reduced. Make a plan which includes milestones and mechanisms to down select technology and design options.
- Applaud efforts to move towards a common management structure for the R&D program but the strong international relationships established by NFMCC must be preserved
- A crucial part of the integrated R&D plan will be timely estimates for the costs of a NF and a MC to demonstrate that such machines are both technically and financially feasible.
- Larger HEP community to be involved in MC detectors studies
- Excellent use of SBIR funds by Muons, Inc

Next 5 (Critical) Years

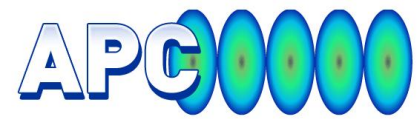
- What is needed to be considered as a feasible lepton collider candidate in 2013:
 1. Coherent MC design at the level of ZDR
 1. MICE experiment (successful) results
 1. Key RF questions answered
 2. Prospects of HTS magnets understood
 3. Muon acceleration techniques explored
- The way: *Muon Collider R&D Program*
 - ✓ To carry out exp. R&D and prepare MC ZDR

Elements of the Program (1)

- **Muon Collider Feasibility Study :**
 - Main deliverable: ZDR
- **Key elements of the Study:**
 - Determine which of three main cooling schemes is most viable/attractive : HCC, Guggenheim, FOFO-snake
 - Develop ring design (consistent with cooling parameters)
 - Complete engineering study, fabrication and bench test for at least one viable 6D cooling channel technology
 - End-to-end simulations (incl complete cooling scheme)
 - Narrow down MC parameters (for one or two energies)
 - Formulate physics objectives, outline detector design
 - Preliminary cost estimates

Muon Collider : as of now

Max. Center-of-mass energy	1.5-4	TeV
Peak Luminosity	$(1-7) \times 10^{34}$	$1/\text{cm}^2\text{s}$
Total # muons/beam	1-8	10^{12}
Repetition rate	6-65	Hz
Beam emittance	2-25	$\pi \text{ um}$
Proton Driver beam power	2-8	MW
Total AC Power Consumption	60-170	MW



Elements of the Program (2)

- **Demonstration of transverse cooling in MICE :**
 - Main deliverable: find the effect and confirm simulations
- **Observations and comments:**
 - This is an international activity, with US playing big role
 - NFMCC manages US-MICE
 - Experiment schedule is slipping – in big part due to limited funding
 - Getting results by 2012 is already challenging
 - Extra M&S and corresponding Labor support could insure success by the deadline

Elements of the Program (3)

- **Address main questions concerning MC RF :**
 - RF in muon cooling section and in collection section
 - Main deliverable: experimental data needed to decide on optimal configuration
- **Key studies:**
 - 201MHz and 805MHz vacuum RF gradient vs B-field, direction
 - Ways to increase gradient (magnetic insulation, Be-win)
 - High Pressure H₂ RF: gradient vs pressure , vs magnetic field, with ionizing beam; “test can” → 805MHz cavity → 201MHz cavity
 - Achievable gradients in low-frequency SC RF

APC Elements of the Program (4&5)

- **Understand prospects of high-field HTS magnets :**
 - Is HTS viable for final stages of cooling?
 - Main deliverable: reasonably large solenoid (3-5 cm dia, 10-20 cm long) with interestingly high field (30T+)
 - Several steps needed: material R&D, cable, technology, inserts, magnets
- **Explore feasibility of main acceleration methods:**
 - Main acceleration is a big (largest) cost and power driver
 - Possibilities: SC RF (1.3GHz), pulsed synchrotron, FFAG
 - Deliverables: at least engineering study, ideally – experimental tests (e.g. pass $1e12$ e- thru NML SC RF cryomodule; or key elements of pulsed magnets, etc)

Needed Resources (est.)

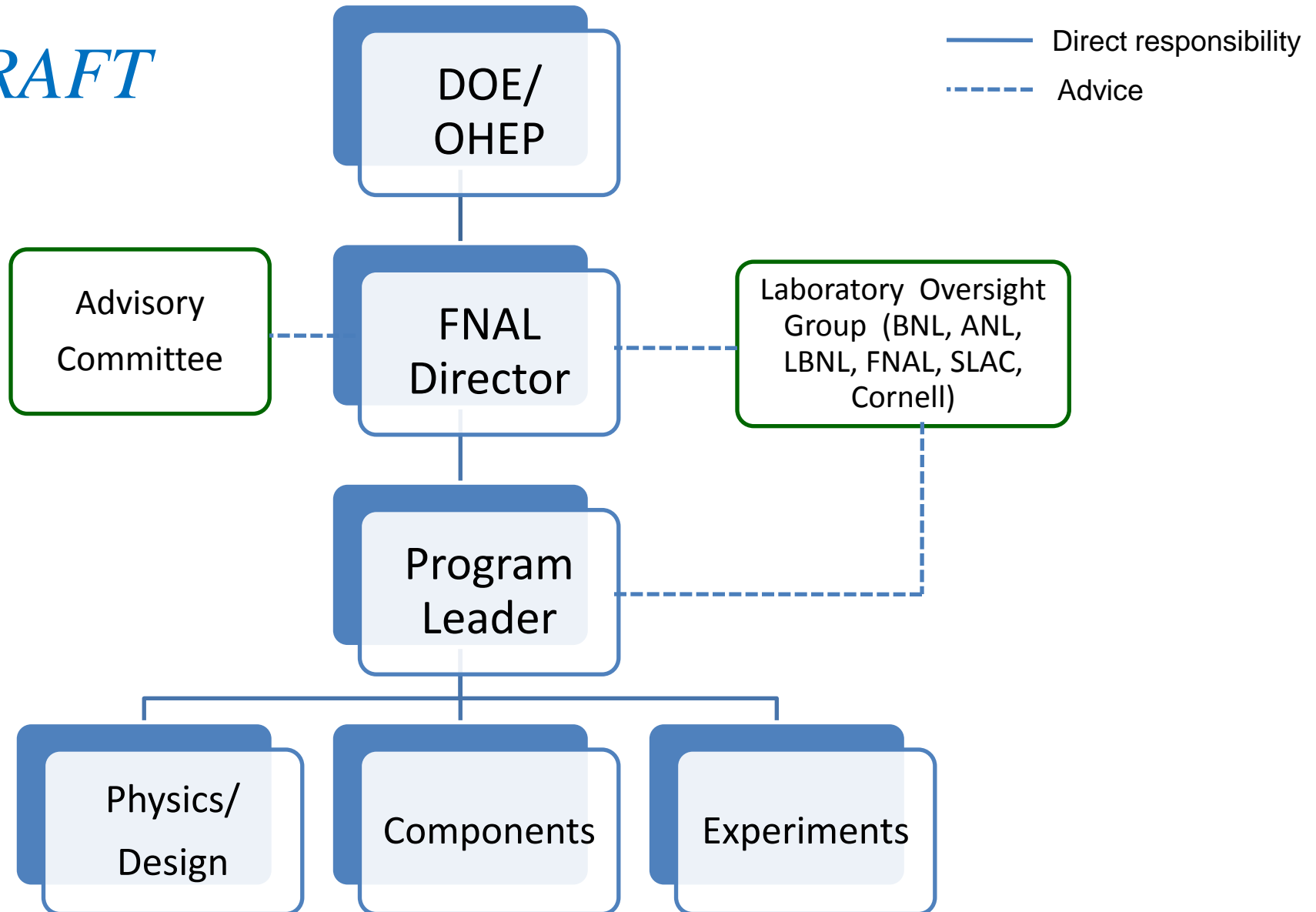
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MC only – w/o NF

	FY09	FY10	FY11	FY12	FY13
MCFS-I	1.6	2.6	4.0	5.2	6.7
MICE	2.3	3.6	1.6	1.0	0.7
RF studies	1.0	1.1	1.5	1.7	1.9
HTS R&D	0.8	0.9	1.7	2.0	2.4
Acceleration	0.3	0.5	0.9	1.1	1.7
TOTAL	6.0	8.7	9.7	10.8	13.4
M&S	2.3	2.9	3.1	3.8	4.4
SWF	3.7	5.8	6.6	7.0	9

Muon Accelerator Research Program

DRAFT



Summary

- **MUTAC went well, they support new initiatives on MARP**
- **Significant increase of support is needed to ~14MS/yr in 2013:**
 - Subject of P5 recommendation and DoE approval
 - DoE Review in Fall'08 is critical, we must be prepared
 - 1st steps: FRA visiting comm (Apr) and AAC (May)
 - MCOG would like to review MARP plan in August
- **What's needed from all of us (here at FNAL):**
 - Get beam in MTA, start beam experiments there
 - Understand Proj-X upgrades for Muon Collider (provide input)
 - Lead the MARP planning effort (set priorities, developm timeline, specify deliverables)